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European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

EPPO data sheets on pests recommended for regulation
Fiches informatives sur les organismes recommandés pour réglementation

Keiferia lycopersicella

Identity

Name: *Keiferia lycopersicella* (Walsingham)
Synonyms: *Pthorimaea lycopersicella* Busck
Gnorimoschema lycopersicella (Busck)
Eucatoptus lycopersicella Walsingham
Taxonomic position: Insecta: Lepidoptera: Gelechiidae
Notes on taxonomy and nomenclature: *Keiferia lycopersicella* (Walsingham) has been the subject of considerable taxonomic confusion since the first specimens were collected on tomatoes in California in 1923. Initially the specimens were misidentified as the eggplant leafminer, *Pthorimaea glochinella* (Zeller), and several early works treated the tomato pinworm under this name. In 1928, Busck described this pest as a new species, *Pthorimaea lycopersicella,* including material from Hawaii, California and Mexico in the type-series. He later synonymized all members of the genus *Pthorimaea* Meyrick with the genus *Gnorimoschema* Busck, thus giving the tomato pinworm the new combination, *Gnorimoschema lycopersicella* (Busck). Subsequently in 1939, Busck moved *G. lycopersicella* and three other members of *Gnorimoschema* to the new genus *Keiferia* with *Pthorimaea lycopersicella* Busck (incorrectly given as *Gnorimoschema lycopersicella)* as the genotype. In 1965, *K. lycopersicella* (Busck) was determined to be conspecific with *Eucatoptus lycopersicella* Walsingham (1897) and the correct combination for this species became *Keiferia lycopersicella* (Walsingham) (after Lin & Trumble 1983).
Common names: Tomato pinworm (English) enrollador de la hoja del tomate, gusano aguja gusano alfiler, quemao, cogollero del tomate, minador del tomate, minador gigante, polilla de tomate (Spanish).
EPPO code: GNORLY
Phytosanitary categorization: EPPO A1 list No. 367.

Hosts

Keiferia lycopersicella attacks mainly tomato (*Solanum lycopersicum)*, but can survive on at least 12 other solanaceous plant species. Occasional losses also have been reported for eggplant (*Solanum melongena*), and potato (*Solanum tuberosum*). Weed hosts reportedly include *S. americanum* var. *nodiflorum*, *Solanum bahamese*, *S. carolinense*, *S. dulcamara*, *S. elaeagnifolium*, *S. puberolum*, *S. umbelliferum*, *S. viarum*, *S. xanthii,* and potentially *Solanum nigrum.*

Geographical distribution

EPPO region: Absent.
EU: Absent.
North America: In Canada, *K. lycopersicella* occurs primarily in greenhouses in British Columbia and in fields and greenhouses in South-Western Ontario. In the USA, this insect occurs widely throughout the southern half of the country from New Jersey to California. It can also be found in Hawaii. The pest is common in Northern Mexico (most notably Sinaloa) and Baja, Mexico.
Central America: Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.
South America: Bolivia, Colombia, Guyana, Peru, and Venezuela.

Biology

Most eggs are oviposited on the undersides of leaves, but when the pest is present at high densities eggs can be found anywhere on the plant. Eggs are typically oviposited singly or in groups of two or three, but may be oviposited in larger numbers. Females oviposit from 50 to 200 eggs. Hatching generally occurs in 3.5 to 9 days.

Larvae of *K. lycopersicella* pass through 4 larval instars. On plants without fruit, the first two instars generally mine inside leaves, feeding on the mesophyll tissues. The later instars fold or roll leaves thereby creating shelters where they can feed in a protected environment. This can reduce effectiveness of contact pesticides. At high populations, larvae will mine in the stems and petioles. When fruit are present, any instars can penetrate into the fruit at any location, but feeding beneath the calyx is most common. Larval development ranges from 9 to 17 days.

Larvae drop to the ground to pupate. After burrowing into the soil to a depth of 1–2 cm, the larvae spin a cocoon with silk and soil particles. Initially green, the pupae become increasing brown as they age. The pupal stage can last as few

as 5 days, or as long as 38 days. At 26°C, the pupal stage lasts 10–11 days. Adults typically survive about a week, but in cooler temperatures may live for over 3 weeks.

The lower developmental threshold has been estimated at 11°C. This insect has no diapauses, so sustained temperatures below 10°C generally prohibit population survival. Eggs will not hatch at temperatures above 41°C, but larvae will continue to develop at temperatures up to 44°C. Developmental time from egg to adult ranges from 18 days at 35°C to 118 days at 14°C. In the Mediterranean climate of coastal Southern California, there are about 8 generations per year. In Sinaloa Mexico, warmer temperatures allow 10 or more generations per year across three tomato production seasons. For additional information see Elmore & Howland (1943), Weinberg & Lange (1980), Lin & Trumble (1985), and Schuster (2006).

Detection and identification

Symptoms

Larvae can damage either foliage or fruit, but most economic losses occur when fruit is attacked. In foliage, the first and second instars feed as leafminers, producing a blotch mine. Later instars typically fold leaves or attach pairs of leaves with silk to create sheltered feeding sites, but may enter stems. Fruit contamination occurs when larvae enter the tomato (typically beneath the calyx); infested fruit are unmarketable and must be discarded. For additional information, see Oatman (1970).

Morphology

Eggs

Newly oviposited eggs are white, but become brown or orange as they age. The eggs are ellipsoid, with an average length of 0.37 and width of 0.23 mm.

Larva

The head capsule is dark brown; body yellowish-grey initially changing to grey with purple blotches or all purple. Newly hatched larvae average 0.85 mm, and attain a maximum length of 5.8–7.9 mm. Typically, larvae have a pale prothorax notum (Fig. 1).

Pupa

Initially green, turning brown prior to eclosion. Pupation occurs underground in a loose pupal cell made of silk, sand grains and other local materials.

Adult

Length is 9–12 mm. Labial palpi have a short furrowed brush on the underside of the second joint, a terminal joint somewhat thickened with scales, and are compressed. The extreme tip is pointed. The head, thorax and wings are mottled brown. The forewings are elongate ovate; the hind wings are pointed and dilated at the tip of the costa in females. The abdomen is dark fuscous above with basal joints slightly ochreous, the underside is light ochreous sprinkled with dark fuscous spots (Fig. 2).

Fig. 1 Damage on tomato. Photo courtesy of J. Trumble.

Means of movement and dispersal

International movement could potentially occur on host plants or fruit. Eggs and small larvae on foliage of transplants can go unnoticed and has been suggested as a mechanism for movement within North America. Shipment of tomatoes with vines attached increases the opportunity for movement during shipment. Packaging (i.e. crates, boxes used for picking and packing tomato and eggplant fruits) may be carry adults or pupae.

Fig. 2 *Keiferia lycopersicella* larvae.

Pest significance

Economic impact

Substantial and recurrent outbreaks of the tomato pinworm have been recorded in North America since the 1920s. Economic losses in the USA and Mexico cost millions of dollars (US) in the 1980s and early 1990s (Oatman, 1970; Trumble & Alvarado-Rodriguez, 1993). Damage on tomato is shown in Fig. 3).

While damage can be caused by foliar feeding, most economic losses result from fruit damage. In tomatoes destined for the fresh market, almost any penetration will result in fruit loss through secondary bacterial infection, cosmetic damage, or insect contamination. For processing tomatoes, the primary losses are to fruit shipments that are rejected because of larval contamination: the presence of any recognizable insect larvae or portion of a larva in consumer products is unacceptable to most consumers.

Damage to potatoes can occur, but has been considered relatively minor throughout the current area of distribution. Damage to eggplant can be quite severe in the warmer areas of production (Mossler & Nesheim, 2010).

Control

Initially, control was almost entirely with frequent applications of multiple pesticides. More recently, populations have been effectively suppressed in tomato production areas in North America and Mexico via a combination of mating disruption with pheromones and insecticides such as abamectin. Attempts to use host plant resistance have not been successful. However, a cultural technique establishing a tomato-free period in Mexico has proven effective at reducing pest pressure in a region where tomatoes can be produced year-round. Rapid destruction of tomato fields following the last harvest can reduce overwintering populations in areas where temperatures are moderate (Pena, 1983).

Fig. 3 *Keiferia lycopersicella* adult.

Phytosanitary risk

Keiferia lycopersicella was listed as an A1 pest in 2012. This species is potentially a serious pest of tomato (and possibly eggplant) in the warmer parts of the EPPO region, both in the field and in protected conditions. In countries where measures are implemented against *Tuta absoluta* (e.g. screenhouses) the impact may be lower.

Phytosanitary measures

EPPO recommends that plants for planting and fruits of tomato and eggplants originating from countries where *K. lycopersicella* occurs should be free from the pest. Only new packaging should be used for those importations to avoid contamination of packaging by the pest.

Acknowledgement

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